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# Medium-Power Plastic NPN Silicon Transistors

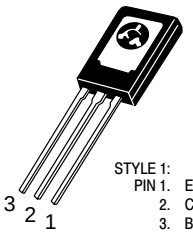
**2N4921 thru 2N4923 ***

*ON Semiconductor Preferred Device

**1 AMPERE GENERAL–PURPOSE POWER TRANSISTORS 40–80 VOLTS 30 WATTS**

. . . designed for driver circuits, switching, and amplifier applications. These high–performance plastic devices feature:

- Low Saturation Voltage — $V_{CE(sat)}$ = 0.6 Vdc (Max) @ $I_C$ = 1.0 Amp
- Excellent Power Dissipation Due to Thermopad Construction — $P_D$ = 30 W @ $T_C$ = 25°C
- Excellent Safe Operating Area
- Gain Specified to $I_C$ = 1.0 Amp
- Complement to PNP 2N4918, 2N4919, 2N4920




**CASE 77–09 TO–225AA TYPE**

***MAXIMUM RATINGS**

| Rating | Symbol | 2N4921 | 2N4922 | 2N4923 | Unit |
|---|---|---|---|---|---|
| Collector–Emitter Voltage | $V_{CEO}$ | 40 | 60 | 80 | Vdc |
| Collector–Base Voltage | $V_{CB}$ | 40 | 60 | 80 | Vdc |
| Emitter–Base Voltage | $V_{EB}$ | 5.0 | | | Vdc |
| Collector Current — Continuous (1) | $I_C$ | 1.0<br>3.0 | | | Adc |
| Base Current — Continuous | $I_B$ | 1.0 | | | Adc |
| Total Power Dissipation @ $T_C$ = 25°C<br>Derate above 25°C | $P_D$ | 30<br>0.24 | | | Watts<br>W/°C |
| Operating & Storage Junction Temperature Range | $T_J$, $T_{stg}$ | –65 to +150 | | | °C |

**THERMAL CHARACTERISTICS (2)**

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case | $\theta_{JC}$ | 4.16 | °C/W |

(1) The 1.0 Amp maximum $I_C$ value is based upon JEDEC current gain requirements. The 3.0 Amp maximum value is based upon actual current handling capability of the device (see Figures 5 and 6).

(2) Recommend use of thermal compound for lowest thermal resistance.

*Indicates JEDEC Registered Data.

**Preferred** devices are ON Semiconductor recommended choices for future use and best overall value.

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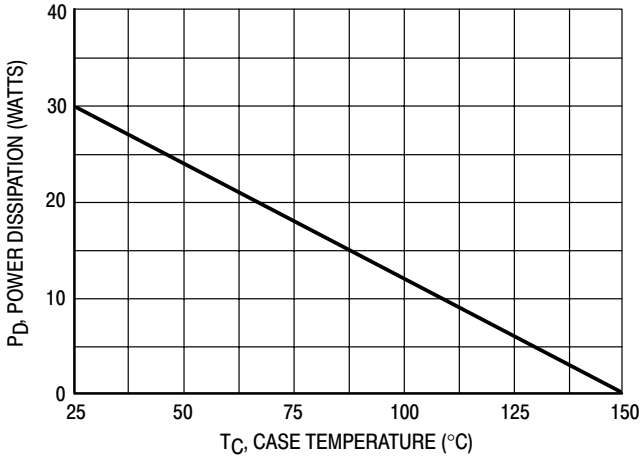



**Figure 1. Power Derating**

Safe Area Curves are indicated by Figure 5. All limits are applicable and must be observed.

**ELECTRICAL CHARACTERISTICS** ($T_C$ = 25°C unless otherwise noted)

| Characteristic | | Symbol | Min | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Collector–Emitter Sustaining Voltage (3)<br>($I_C$ = 0.1 Adc, $I_B$ = 0) | 2N4921<br>2N4922<br>2N4923 | $V_{CEO(sus)}$ | <br>40<br>60<br>80 | <br>—<br>—<br>— | Vdc |
| Collector Cutoff Current<br>($V_{CE}$ = 20 Vdc, $I_B$ = 0)<br>($V_{CE}$ = 30 Vdc, $I_B$ = 0)<br>($V_{CE}$ = 40 Vdc, $I_B$ = 0) | <br>2N4921<br>2N4922<br>2N4923 | $I_{CEO}$ | <br>—<br>—<br>— | <br>0.5<br>0.5<br>0.5 | mAdc |
| Collector Cutoff Current<br>($V_{CE}$ = Rated $V_{CEO}$, $V_{EB(off)}$ = 1.5 Vdc)<br>($V_{CE}$ = Rated $V_{CEO}$, $V_{EB(off)}$ = 1.5 Vdc, $T_C$ = 125°C | | $I_{CEX}$ | <br>—<br>— | <br>0.1<br>0.5 | mAdc |
| Collector Cutoff Current<br>($V_{CB}$ = Rated $V_{CB}$, $I_E$ = 0) | | $I_{CBO}$ | — | 0.1 | mAdc |
| Emitter Cutoff Current<br>($V_{EB}$ = 5.0 Vdc, $I_C$ = 0) | | $I_{EBO}$ | — | 1.0 | mAdc |
| **ON CHARACTERISTICS** | | | | | |
| DC Current Gain (3)<br>($I_C$ = 50 mAdc, $V_{CE}$ = 1.0 Vdc)<br>($I_C$ = 500 mAdc, $V_{CE}$ = 1.0 Vdc)<br>($I_C$ = 1.0 Adc, $V_{CE}$ = 1.0 Vdc) | | $h_{FE}$ | <br>40<br>30<br>10 | <br>—<br>150<br>— | — |
| Collector–Emitter Saturation Voltage (3)<br>($I_C$ = 1.0 Adc, $I_B$ = 0.1 Adc) | | $V_{CE(sat)}$ | — | 0.6 | Vdc |
| Base–Emitter Saturation Voltage (3)<br>($I_C$ = 1.0 Adc, $I_B$ = 0.1 Adc) | | $V_{BE(sat)}$ | — | 1.3 | Vdc |
| Base–Emitter On Voltage (3)<br>($I_C$ = 1.0 Adc, $V_{CE}$ = 1.0 Vdc) | | $V_{BE(on)}$ | — | 1.3 | Vdc |
| **SMALL–SIGNAL CHARACTERISTICS** | | | | | |
| Current–Gain — Bandwidth Product ($I_C$ = 250 mAdc, $V_{CE}$ = 10 Vdc, f = 1.0 MHz) | | $f_T$ | 3.0 | — | MHz |
| Output Capacitance ($V_{CB}$ = 10 Vdc, $I_E$ = 0, f = 100 kHz) | | $C_{ob}$ | — | 100 | pF |
| Small–Signal Current Gain ($I_C$ = 250 mAdc, $V_{CE}$ = 10 Vdc, f = 1.0 kHz) | | $h_{fe}$ | 25 | — | — |

(3) Pulse Test: PW ≈ 300 μs, Duty Cycle ≈ 2.0%.
*Indicates JEDEC Registered Data.

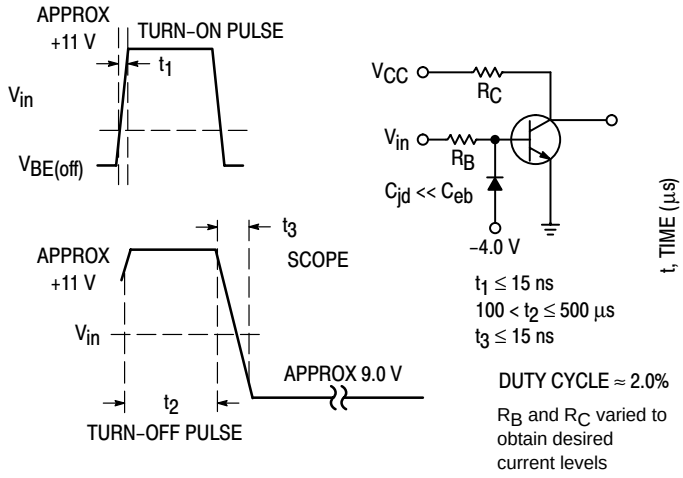



**Figure 2. Switching Time Equivalent Circuit**

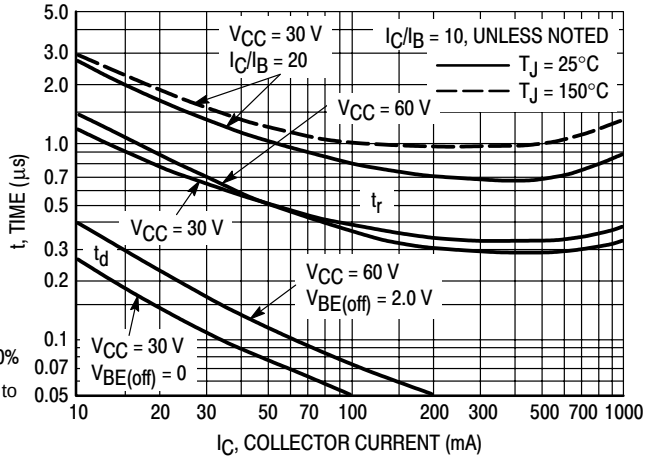



**Figure 3. Turn–On Time**

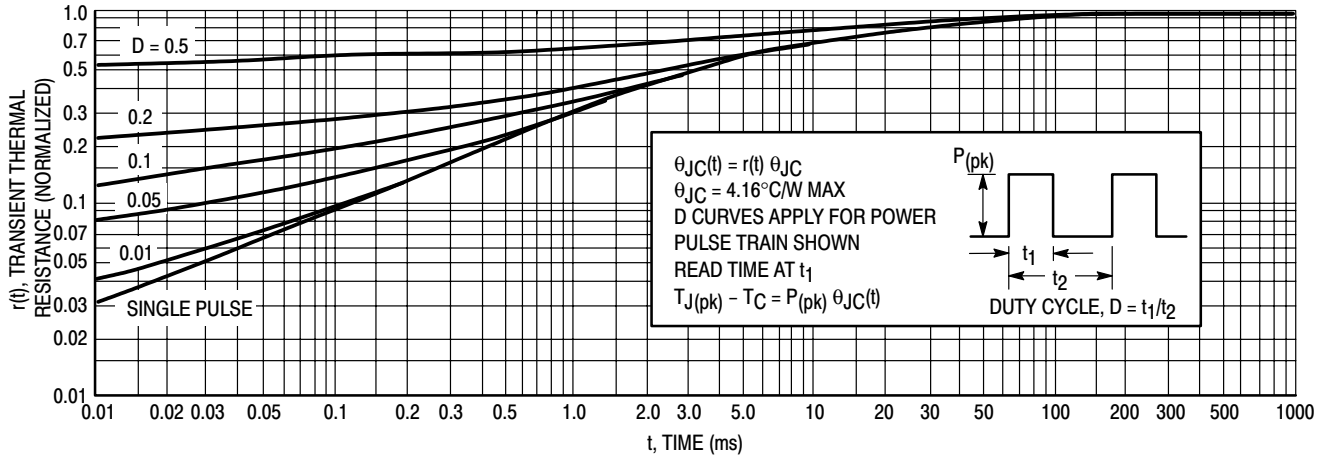



**Figure 4. Thermal Response**

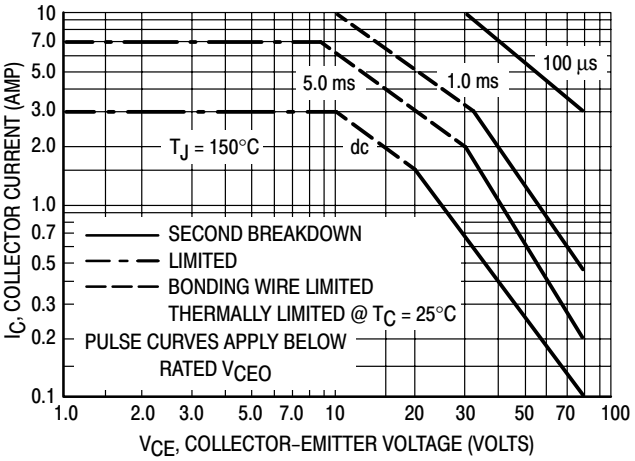



**Figure 5. Active−Region Safe Operating Area**

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate $I_C - V_{CE}$ operation i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 5 is based on $T_{J(pk)} = 150°C$; $T_C$ is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} \leq 150°C$. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

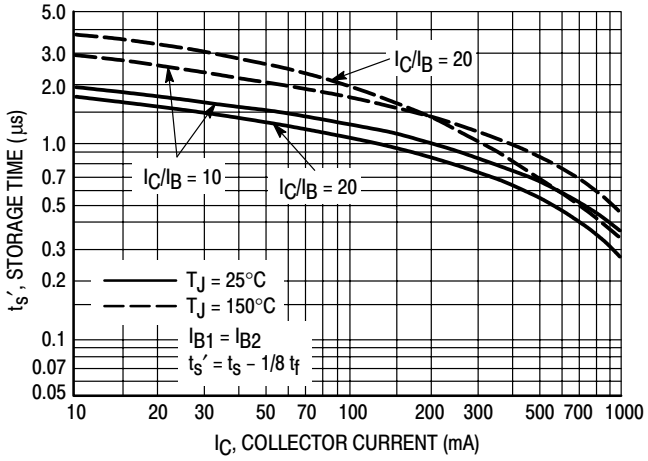



**Figure 6. Storage Time**

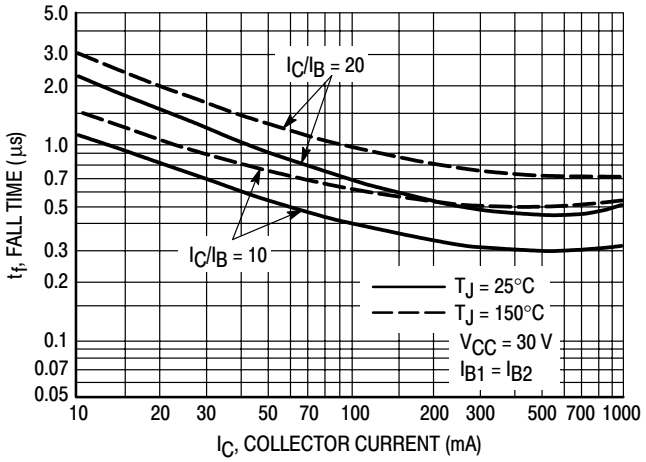



**Figure 7. Fall Time**

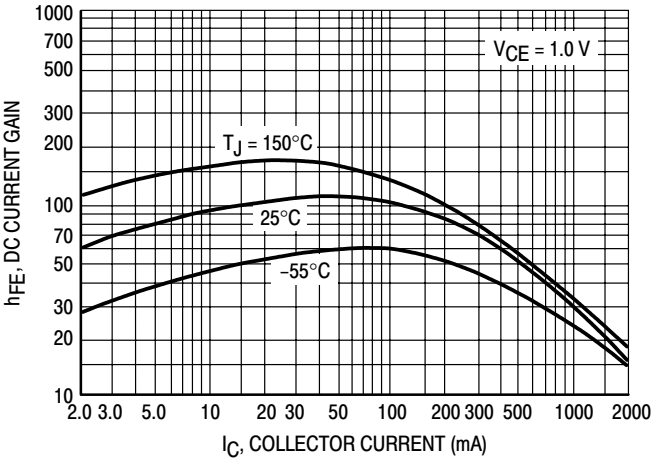



**Figure 8. Current Gain**

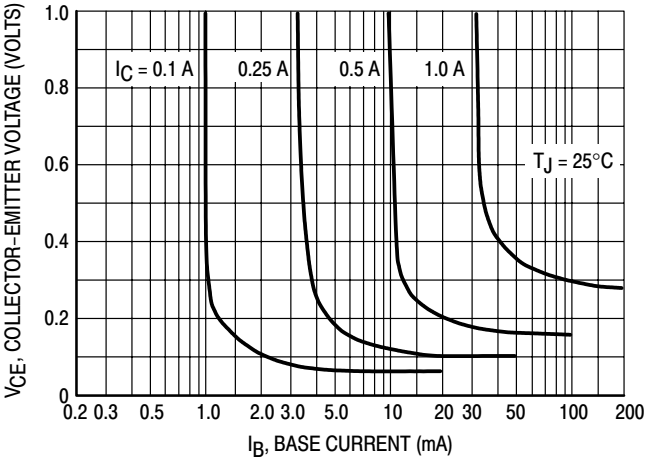



**Figure 9. Collector Saturation Region**

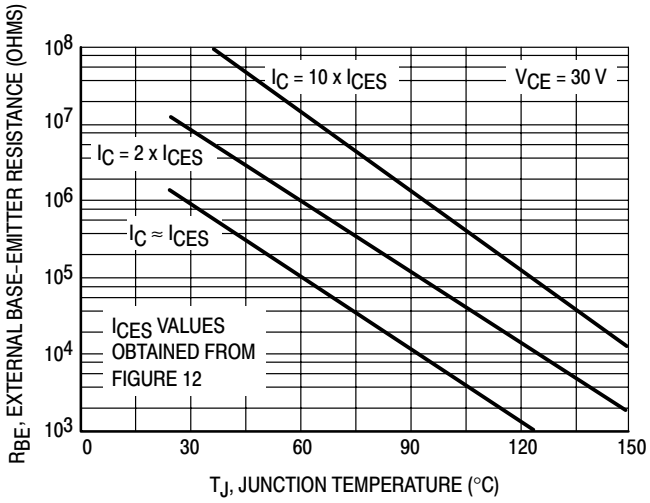

$I_C$ = 10 x $I_{CES}$
$V_{CE}$ = 30 V
$I_C$ = 2 x $I_{CES}$
$I_C \approx I_{CES}$
$I_{CES}$ VALUES OBTAINED FROM FIGURE 12
$R_{BE}$, EXTERNAL BASE−EMITTER RESISTANCE (OHMS)
$T_J$, JUNCTION TEMPERATURE (°C)

**Figure 10. Effects of Base−Emitter Resistance**

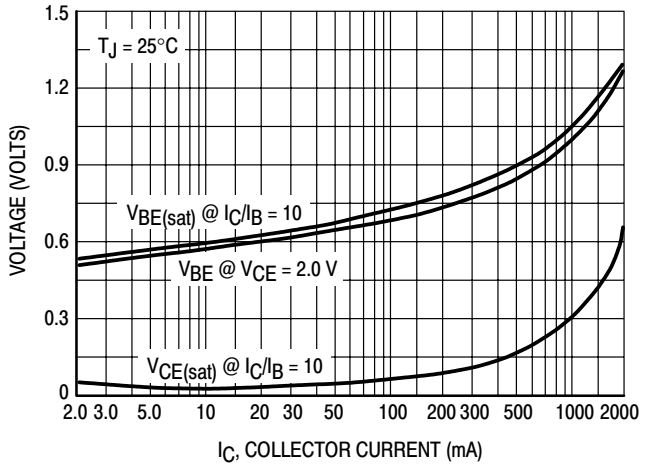



**Figure 11. “On” Voltage**

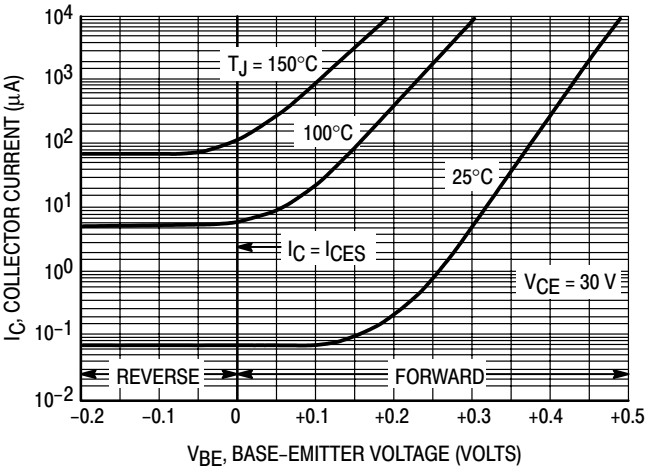



**Figure 12. Collector Cut−Off Region**

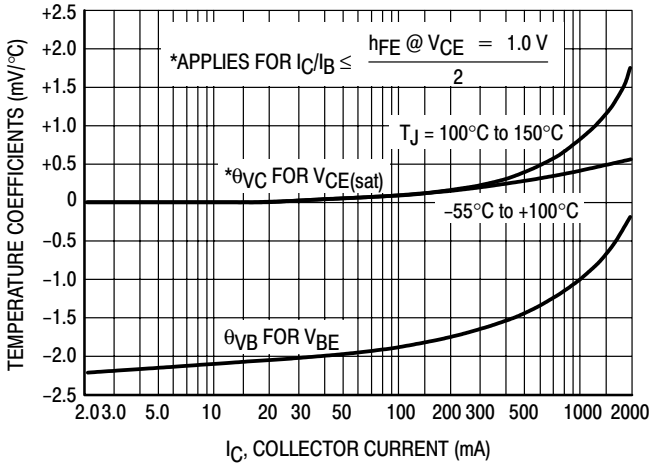
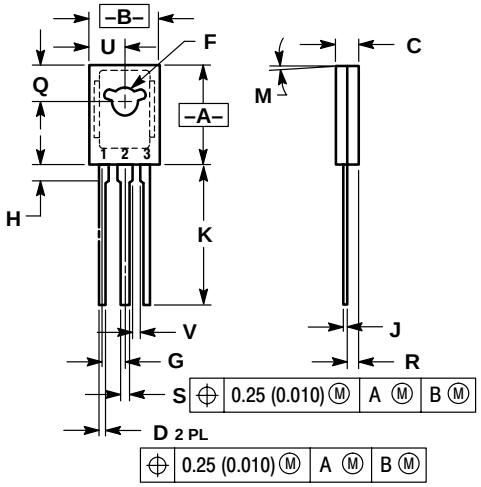

*APPLIES FOR $I_C/I_B \leq \frac{h_{FE} @ V_{CE} = 1.0 V}{2}$
$T_J$ = 100°C to 150°C
*$\theta_{VC}$ FOR $V_{CE(sat)}$
−55°C to +100°C
$\theta_{VB}$ FOR $V_{BE}$
TEMPERATURE COEFFICIENTS (mV/°C)
$I_C$, COLLECTOR CURRENT (mA)

**Figure 13. Temperature Coefficients**

## PACKAGE DIMENSIONS

### CASE 77–08
### TO–225AA TYPE
### ISSUE V




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.425 | 0.435 | 10.80 | 11.04 |
| B | 0.295 | 0.305 | 7.50 | 7.74 |
| C | 0.095 | 0.105 | 2.42 | 2.66 |
| D | 0.020 | 0.026 | 0.51 | 0.66 |
| F | 0.115 | 0.130 | 2.93 | 3.30 |
| G | 0.094 BSC | | 2.39 BSC | |
| H | 0.050 | 0.095 | 1.27 | 2.41 |
| J | 0.015 | 0.025 | 0.39 | 0.63 |
| K | 0.575 | 0.655 | 14.61 | 16.63 |
| M | 5° TYP | | 5° TYP | |
| Q | 0.148 | 0.158 | 3.76 | 4.01 |
| R | 0.045 | 0.055 | 1.15 | 1.39 |
| S | 0.025 | 0.035 | 0.64 | 0.88 |
| U | 0.145 | 0.155 | 3.69 | 3.93 |
| V | 0.040 | --- | 1.02 | --- |

STYLE 1:
PIN 1. EMITTER
2. COLLECTOR
3. BASE

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